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EXAMINER	
CHEN, ERIC BRICE	
ART UNIT	**PAPER NUMBER**
1765	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/509,370	SUGAWARA ET AL.	
	Examiner	Art Unit	
	Eric B. Chen	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *1 February 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *16-72* is/are pending in the application.

4a) Of the above claim(s) *66-70* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *16-65,71, and 72* is/are rejected.

7)☒ Claim(s) *25 and 34-37* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Newly submitted claims 66-70 directed to an invention that is independent or distinct from the invention originally claimed for the following reasons: Restriction is required under 35 U.S.C. 121 and 372. This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In accordance with 37 CFR 1.499, applicant is required, in reply to this action, to elect a single invention to which the claims must be restricted.

Group I, claims 16-65, 71, and 72, drawn a process for forming an insulating film.

Group II, claims 66-70, drawn to a semiconductor device manufacturing system.

2. The inventions listed as Groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: Group II claims require the additional elements of: a cassette containing a substrate; a transportation chamber for transporting the substrate; a first arm for disposing the substrate in the transportation chamber; a plurality of plasma processing units for conducting treatments on the substrate, which is to be introduced into the plasma processing unit via the arm connected to the transportation chamber; and a load lock unit for conducting the communication and isolation between the cassette and the transportation chamber via a second arm, which are not required for Group I.

3. Since Applicants have received an action on the merits for the originally presented invention, this invention has been constructively elected by original presentation for prosecution on the merits. Accordingly, claims 66-70 are withdrawn from consideration as being directed to a non-elected invention. See 37 CFR 1.142(b) and MPEP § 821.03.

4. Applicants are reminded that upon the cancellation of claims to a non-elected invention, the inventorship must be amended in compliance with 37 CFR 1.48(b) if one or more of the currently named inventors is no longer an inventor of at least one claim remaining in the application. Any amendment of inventorship must be accompanied by a request under 37 CFR 1.48(b) and by the fee required under 37 CFR 1.17(i).

Claim Objections

5. Claim 25 objected to because of the following informalities: for the second step, apparently "rare" should be -- rare gas --. Appropriate correction is required.

6. Claims 34-37 are objected to because of the following informalities: apparently "3133 Pa" should be -- 133 Pa --. Appropriate correction is required.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> **The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.**

8. Claims 34-37 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claims contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the application was filed, had possession of the claimed invention. Specifically, there is no support in the Specification for a pressure of 3133 Pa. Example 1 in the Specification discloses a pressure of ranging from 7 Pa to 133 Pa (paragraphs 0119-0120).

Claim Rejections - 35 USC § 103

9. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> **(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.**

10. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

11. Claims 16-22, 25-31, 54-55, 64-65, and 71-72 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi (U.S. Patent Appl. Pub. No. 2002/0014666) ("Ohmi I"), in view of Wolf et al., *Silicon Processing for the VLSI Era*, Vol. 1, Lattice Press (1986) ("Wolf I"), in further view of Mintz et al. (U.S. Patent No. 5,618,282).

12. As to claim 16, Ohmi I discloses a process for forming an insulating film on the surface of a substrate for electronic device, comprising: a second step of oxidizing the substrate (11) with plasma based on a second process gas comprising at least a rare gas and oxygen (paragraphs 0090-0091), to thereby form an oxide film thereon (12A) (paragraph 0095; Figure 10A-10B).

13. Ohmi I does not expressly disclose a first step of cleaning the substrate with plasma based on a first process gas comprising at least a rare gas. Wolf I teaches that scrupulously clean wafers are critical for obtaining high yields for semiconductor fabrication (page 514). Mintz teaches a cleaning step comprising treatment based on plasma based (column 1, lines 15-18) on a process gas comprising at least a rare gas (column 6, lines 15-23). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a step of cleaning, and the cleaning step comprises treatment based on plasma based on a process gas comprising at least a rare gas. One who is skilled in the art would be motivated to obtain a high yield and to adopt a method known to accomplish the task of wafer cleaning.

14. Mintz teaches that the first step is performed using plasma processing (column 6, lines 15-25). Ohmi I teaches that the second step is performed using plasma

processing (paragraphs 0088-0091). Thus, the first and second steps are conducted under the same operation principle (plasma processing).

15. As to claim 17, Mintz discloses that the first process gas comprises hydrogen gas (column 6, lines 21-23).

16. As to claim 18, Mintz does not expressly disclose that the first step is conducted at a pressure of 7-133 Pa. However, Mintz discloses a pressure of 5.33 Pa (40 mTorr) (column 6, lines 15-16). It should be noted that this pressure range is similar to Applicants' pressure. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a pressure of 7-133 Pa. One who is skilled in the art would be motivated to use a pressure similar to 5.33 Pa, which is known to be effective for wafer cleaning.

17. As to claim 19, Mintz teaches that the first step is performed using plasma processing (column 6, lines 15-25). Ohmi I teaches that the second step is performed using plasma processing (paragraphs 0088-0091). Thus, the first and second steps are conducted under the same operation principle (plasma processing).

18. As to claim 20, Ohmi I discloses a third step to be conducted after the second step, of nitriding the oxide film with plasma based on a third process gas comprising at least a rare gas and nitrogen (paragraph 0092).

19. As to claim 21, Ohmi I does not expressly disclose a fourth step to be conducted after the third step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas. However, Ohmi I discloses that the nitride layer formed in the third step may be formed with a mixed gas of nitrogen and hydrogen to reduce the

trapping of electrons or holes in the film (paragraphs 0077, 0092). Moreover, case law has held that the transposition of two steps or the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). Ohmi I simultaneously forms and treats the silicon nitride film with nitrogen and hydrogen (paragraphs 0077, 0092). Thus, Applicants' fourth step to be conducted after the third step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas is the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a fourth step to be conducted after the third step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas.

20. As to claim 22, Ohmi I does not expressly disclose a fifth step to be conducted after the second step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas. However, Ohmi I discloses that the nitride layer formed after the second step may be formed with a mixed gas of nitrogen and hydrogen to reduce the trapping of electrons or holes in the film (paragraphs 0077, 0092). Moreover, case law has held that the transposition of two steps or the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). Ohmi I

simultaneously forms and treats the silicon nitride film with nitrogen and hydrogen (paragraphs 0077, 0092). Thus, Applicants' fifth step to be conducted after the second step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas is the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a fifth step to be conducted after the second step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas.

21. As to claim 25, Ohmi I discloses a process for forming an insulating film on the surface of a substrate for electronic device, comprising: a second step of nitriding the substrate (11) with plasma based on a second process gas comprising at least a rare gas and nitrogen (paragraphs 0090-0091), to thereby form a nitride film thereon (12B) (paragraph 0095; Figure 10A-10B).

22. Ohmi I does not expressly disclose a first step of cleaning the substrate with plasma based on a first process gas comprising at least a rare gas. Wolf I teaches that scrupulously clean wafers are critical for obtaining high yields for semiconductor fabrication (page 514). Mintz teaches a cleaning step comprising treatment based on plasma based (column 1, lines 15-18) on a process gas comprising at least a rare gas (column 6, lines 15-23). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a step of cleaning, and the cleaning step comprises treatment based on plasma based on a process gas comprising at least a rare gas. One who is skilled in the art would be motivated to

obtain a high yield and to adopt a method known to accomplish the task of wafer cleaning.

23. Mintz teaches that the first step is performed using plasma processing (column 6, lines 15-25). Ohmi I teaches that the second step is performed using plasma processing (paragraphs 0088-0091). Thus, the first and second steps are conducted under the same operation principle (plasma processing).

24. As to claim 26, Mintz discloses that the first process gas comprises hydrogen gas (column 6, lines 21-23).

25. As to claim 27, Mintz does not expressly disclose that the first step is conducted at a pressure of 7-133 Pa. However, Mintz discloses a pressure of 5.33 Pa (40 mTorr) (column 6, lines 15-16). It should be noted that this pressure range is similar to Applicants' pressure. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a pressure of 7-133 Pa. One who is skilled in the art would be motivated to use a pressure similar to 5.33 Pa, which is known to be effective for wafer cleaning.

26. As to claim 28, Mintz teaches that the first step is performed using plasma processing (column 6, lines 15-25). Ohmi I teaches that the second step is performed using plasma processing (paragraphs 0088-0091). Thus, the first and second steps are conducted under the same operation principle (plasma processing).

27. As to claim 29, Ohmi I does not expressly disclose comprises a third step to be conducted after the second step, of oxidizing the nitride film with plasma based on a third process gas comprising at least a rare gas and oxygen. However, Ohmi I

discloses that a stacked nitride/oxide/nitride structure in place of oxide film (12A) and nitride film (12B). Ohmi I further discloses oxidizing the silicon with plasma based on a third process gas comprising at least a rare gas and oxygen (paragraph 0029). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a third step to be conducted after the second step, of oxidizing the nitride film with plasma based on a third process gas comprising at least a rare gas and oxygen, because there is a suggestion of forming a stacked nitride/oxide/nitride structure in place of oxide film (12A) and nitride film (12B).

28. As to claim 30, Ohmi I does not expressly disclose a fourth step to be conducted after the third step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas. However, Ohmi I discloses that the nitride layer formed in the third step may be formed with a mixed gas of nitrogen and hydrogen to reduce the trapping of electrons or holes in the film (paragraphs 0077, 0092). Moreover, case law has held that the transposition of two steps or the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). Ohmi I simultaneously forms and treats the silicon nitride film with nitrogen and hydrogen (paragraphs 0077, 0092). Thus, Applicants' fourth step to be conducted after the third step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas is the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result. Therefore, it would have been obvious to one

of ordinary skill in the art at the time the invention was made to include a fourth step to be conducted after the third step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas.

29. As to claim 31, Ohmi I does not expressly disclose a fifth step to be conducted after the second step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas. However, Ohmi I discloses that the nitride layer formed after the second step may be formed with a mixed gas of nitrogen and hydrogen to reduce the trapping of electrons or holes in the film (paragraphs 0077, 0092). Moreover, case law has held that the transposition of two steps or the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result, does not patentably distinguish the processes. *Ex parte Rubin,* 128 USPQ 440 (Bd. App. 1959); MPEP § 2144.04 (IV)(C). Ohmi I simultaneously forms and treats the silicon nitride film with nitrogen and hydrogen (paragraphs 0077, 0092). Thus, Applicants' fifth step to be conducted after the second step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas is the splitting of one step into two steps, where the processes are substantially identical or equivalent in terms of function, manner and result. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a fifth step to be conducted after the second step, of treating the oxide film with plasma based on a fourth process gas comprising hydrogen gas.

30. As to claim 54 and 55, Ohmi I discloses that the plasma is generated using microwave irradiation (paragraph 0042).

31. As to claim 64 and 65, Ohmi I discloses that the insulating film is a gate insulator (paragraph 0088).

32. As to claims 71 and 72, Ohmi I does not expressly disclose that the substrate is subjected to wet cleaning prior to the plasma cleaning in the first embodiment. Wolf I teaches that scrupulously clean wafers are critical for obtaining high yields for semiconductor fabrication (page 514). In the second embodiment, Ohmi I discloses that the substrate is subjected to wet cleaning ("RCA cleaning process," paragraphs 0105). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to subject the substrate to wet cleaning prior to the plasma cleaning. One who is skilled in the art would be motivated to obtain a high yield and to adopt a method known to accomplish the task of wafer cleaning.

Claim Rejections - 35 USC § 103

33. Claims 23, 24, 32, 33, and 56-59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi, in view of Wolf I, in further view of Mintz, in further view of Wolf, *Silicon Processing for the VLSI Era*, Vol. 4, Lattice Press (2002) ("Wolf IV").

34. As to claim 23, Ohmi I does not expressly disclose a step to be conducted after the fourth step, of forming a High-k film. Ohmi I discloses that additional layers may be formed after oxide film (12A) and nitride film (12B) (paragraph 0100). Thus, there is a suggestion of forming an additional dielectric layer over (12A/12B) (paragraph 0100). Wolf IV further teaches a need for high-k dielectrics ($k > 7$) in metal-oxide-semiconductor field effect transistors, due to the increase in undesirable tunneling

effects associated with thinner gate oxides, a result of device miniaturization (page 145). Wolf also teaches that many important high-k materials are currently under investigation as a replacement for silicon oxide as a gate dielectric (pages 145-46). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a step to be conducted after the fourth step for forming a High-k film. One who is skilled in the art would be motivated to find a high-k material replacement for silicon oxide as a gate dielectric to reduce the undesirable tunneling effects.

35. As to claims 24 and 33, Ohmi I does not expressly disclose a step to be conducted after the fifth step, of forming a High-k film. Ohmi I discloses that additional layers may be formed after oxide film (12A) and nitride film (12B) (paragraph 0100). Thus, there is a suggestion of forming an additional dielectric layer over (12A/12B). Wolf IV further teaches a need for high-k dielectrics ($k > 7$) in metal-oxide-semiconductor field effect transistors, due to the increase in undesirable tunneling effects associated with thinner gate oxides, a result of device miniaturization (page 145). Wolf also teaches that many important high-k materials are currently under investigation as a replacement for silicon oxide as a gate dielectric (pages 145-46). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a step to be conducted after the fifth step for forming a High-k film. One who is skilled in the art would be motivated to find a high-k material replacement for silicon oxide as a gate dielectric to reduce the undesirable tunneling effects.

36. As to claim 32, Ohmi I does not expressly disclose a step to be conducted after the fourth step, of forming a High-k film. Ohmi I discloses that additional layers may be formed after oxide film (12A) and nitride film (12B) (paragraph 0100). Thus, there is a suggestion of forming an additional dielectric layer over (12A/12B). Wolf IV further teaches a need for high-k dielectrics (k > 7) in metal-oxide-semiconductor field effect transistors, due to the increase in undesirable tunneling effects associated with thinner gate oxides, a result of device miniaturization (page 145). Wolf also teaches that many important high-k materials are currently under investigation as a replacement for silicon oxide as a gate dielectric (pages 145-46). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to include a step to be conducted after the fourth step for forming a High-k film. One who is skilled in the art would be motivated to find a high-k material replacement for silicon oxide as a gate dielectric to reduce the undesirable tunneling effects.

37. As to claims 56-59, Ohmi I does not expressly disclose the High-k film comprises at least one material selected from the group consisting of Al_2O_3, ZrO_2, HfO_2, Ta_2O_5, silicates and aluminates. However, Wolf IV teaches that important high-k materials for metal-oxide-semiconductor field effect transistors include Al_2O_3, ZrO_2, HfO_2, and Ta_2O_5 (Table 4-1, page 146). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made use the High-k film comprises at least one material selected from the group consisting of Al_2O_3, ZrO_2, HfO_2, Ta_2O_5. One who is skilled in the art would be motivated to select a high-k material that is recognized as an important material for metal-oxide-semiconductor field effect transistor applications.

Claim Rejections - 35 USC § 103

38. Claims 34-37 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi, in view of Wolf I, in further view of Mintz, in further view of Kern, *Handbook of Semiconductor Wafer Cleaning Technology*, Noyes Publications (1993).

39. As to claims 34-37, Ohmi I does not expressly disclose that a hydrogen plasma pressure is conducted at a pressure of 133 Pa. However, Kern teaches a hydrogen plasma cleaning method (page 225), including a hydrogen plasma pressure of 1 Torr (or 133 Pa) (Table 3, page 226). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a hydrogen plasma pressure of 133 Pa, because Kern teaches that this pressure is effective for cleaning wafers.

Claim Rejections - 35 USC § 103

40. Claims 38-41 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi, in view of Wolf I, in further view of Mintz, in further view of Kern, in further view of Cohen et al. (U.S. Patent Appl. Pub. No. 2002/0009892).

41. As to claims 38-41, Ohmi I does not expressly disclose that the hydrogen plasma processing is conducted at a rate gas flow rate of 500-2000 sccm, and a hydrogen gas flow rate of 4-500 sccm. Cohen discloses a method for hydrogen plasma cleaning (paragraph 0021), including a hydrogen flow of up to 2000 sccm (paragraph 0033). It should be noted that Cohen's gas flow range overlaps with Applicants' range. Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use hydrogen plasma processing conducted at a rate gas flow

rate of 500-2000 sccm, and a hydrogen gas flow rate of 4-500 sccm. One who is skilled in the art would be motivated to use a gas flow rate similar to Cohen's gas flow rate, which is known to be effective for wafer cleaning.

Claim Rejections - 35 USC § 103

42. Claims 48-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi, in view of Wolf I, in further view of Mintz, in further view of Rossnagel et al., *Handbook of Plasma Processing*, Noyes Publications (1990).

43. As to claims 48 and 49, Ohmi I does not expressly disclose that the plasma has an electron temperature of 0.5-2 eV. However, Rossnagel teaches that a typical electron temperature for a plasma etch (or clean) is 3 to 30 eV (Table 1, page 198). It should be noted that Applicants' electron temperature range is similar to Rossnagel's temperature range. Therefore, because Applicants' method includes forming a plasma, that plasma would naturally encompass similar properties, including an electron temperature of 0.5-2 eV.

44. As to claims 50 and 51, Ohmi I does not expressly disclose that the plasma has a plasma density of $1x10^{10}$ to $5x10^{12}/cm^3$. However, Rossnagel teaches that a typical density for a plasma etch (or clean) is 10^9 to 10^{10} cm^{-3} (Table 1, page 198). It should be noted that Applicants' density range is similar to Rossnagel's density range. Therefore, because Applicants' method includes forming a plasma, that plasma would naturally encompass similar properties, including a density of $1x10^{10}$ to $5x10^{12}/cm^3$.

Claim Rejections - 35 USC § 103

45. Claims 52 and 53 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi I, in view of Wolf I, in further view of Mintz, in further view of Ohmi et al. (U.S. Patent No. 6,357,385) ("Ohmi II").

46. As to claims 52 and 53, Ohmi I discloses that the plasma is generated by using a plane antenna member (106) (paragraph 0043). Ohmi I does not expressly disclose a plane antenna member having a plurality of slots. Ohmi II discloses a plane antenna member (201) with a plurality of slots (110) (column 19, lines 43-48; Figure 2). Ohmi II further discloses that the plurality of slots (110) result in the more uniform radiation of electromagnetic waves (column 19, lines 49-61) for the creation of a plasma (column 20, lines 7-11). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a plane antenna member having a plurality of slots. One who is skilled in the art would be motivated in creating a more uniform radiation of electromagnetic waves for the creation of a plasma.

Claim Rejections - 35 USC § 103

47. Claims 60-63 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohmi, in view of Wolf I, in further view of Mintz, in further view of Wolf IV, in further view of Hallyal et al. (U.S. Patent No. 6,451,641).

48. As to claims 60-63, Ohmi does not expressly disclose that the High-k film is a silicate or aluminate, wherein the silicate is ZrSiO or HfSiO or the aluminate is ZrAlO. Hallyal discloses the hafnium silicate (or HfSiO) is a high-k material (column 3,lines 20-

32) suited for a gate dielectric (column 2, lines 33-34). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use HfSiO as the high-k film. One who is skilled in the art would be motivated to find a high-k material replacement for silicon oxide as a gate dielectric to reduce the undesirable tunneling effects, and to use a material known to be effective as a gate dielectric.

Response to Arguments

49. Applicants' arguments filed (Applicants' Remarks, page 13-14), filed Feb. 1, 2006, regarding the combination of the Ohmi, Mintz, and Wolf references have been fully considered, but they are not persuasive.

50. First, Applicants have not provided sufficient arguments to overcome the *prima facie* case of obviousness. The Wolf reference teaches that scrupulously clean wafers are critical for obtaining high yields for semiconductor fabrication (page 514). Mintz teaches a method for cleaning a wafer with a hydrogen plasma, known to be effective for cleaning silicon (column 6, lines 15-23). Thus, motivation exists to combine the teaching of Ohmi, Mintz, and Wolf in order to increase process yields using a method known to be effective at cleaning silicon, a plasma that includes a rare gas (argon) and hydrogen. Applicants' arguments do not adequately address the motivation to combine the applied references.

51. Second, claims 15 and 25 recite "a first process gas comprising at least a rare gas..." The transitional term "comprising", which is synonymous with "including," "containing," or "characterized by," is inclusive or open-ended and does not exclude

additional, unrecited elements or method steps. MPEP § 2111.03. Although Mintz discloses a fluorine gas (column 15, lines 21-23), claims 15 and 25 do not exclude the use of fluorine gas. Applicants have not provided any additional evidence (e.g., unexpected results) to overcome the *prima facie* case of obviousness.

Conclusion

52. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eric B. Chen whose telephone number is (571) 272-

2947. The examiner can normally be reached on Monday through Friday, 8AM to 4:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER

EBC

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March 21, 2006